1,009,559

# PATENT SPECIFICATION

DRAWINGS ATTACHED

**1,009,559**

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COMPLETE SPECIFICATION



## Improvements relating to Structural Members

We, DEXION LIMITED, of Empire Way, Wembley Park, Middlesex, a Company incorporated under the laws of Great Britain, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention concerns improvements relating to structural members, that is members to be used as, or as parts of, girders, beams, joists, purlins, columns and other like elements in buildings, roof trusses, light bridges, towers and like structures. An object of the invention is to provide such a member which is not only capable of sustaining bending, shearing and twisting forces as well as compressive and tensional forces, but is also extremely versatile with respect to the ways in which it can be used singly or in combinations of two or more members, to the ways in which members can be strongly interconnected by a variety of methods to form a load-carrying framework and to the ways in which other members and parts, for example cladding or filling members or parts, can be used with it.

In cross section, a structural member in accordance with the invention has a general profile of hollow T-shape and comprises a body portion of channel section and two wing portions each of which is of channel section and consists of a flange extending outwardly from the adjacent flange of the body portion and making rather less than a right angle therewith, a web extending substantially parallel to the said flange of the body portion, and a flange extending inwardly from the web substantially parallel to the web of the body portion, the distance between the free edges of the latter flanges of the wing portions being not less than the distance between the insides of the flanges of the body portion. Advantageously, the former distance is greater than the distance between the outsides of the flanges of the body portion. Preferably, the web of the wing portion is substantially half as wide as the web of the body portion.

Such a member may be made of steel or other metal or of a variety of other materials, for example laminated or bonded-particle wood or glass-fibre filled synthetic resin, and may be shaped in a variety of ways, for example from relatively thin sheet material by hot or cold blending or rolling, or by extrusion or moulding.

Forms of embodiment of structural members in accordance with the invention and modes of use of such members will now be more fully described with reference to the accompanying drawings, in which:—

Figure 1 is a cross-section through one form of structural member,

Figure 2 is a similar section through another form of such member,

Figures 3 and 4 are sections to a smaller scale illustrating examples of ways in which two members can be combined,

Figures 5 and 6 are a cross section and side elevation of one example of lattice girder employing such members,

Figure 7 is a cross section of another example of lattice girder,

Figure 8 is a cross section, to the same scale as Figure 1, through a diagonal member for a lattice girder, and

Figures 9 to 14 illustrate examples of a variety of attachment provisions which can be adopted with the structural members.

The structural member 1 illustrated in section in Figure 1 is rolled from steel strip with a general profile of hollow T-shape. It comprises a body portion 2 of approximately square, channel, section and two wing portions 3 each of which is of substantially rectangular, channel, section. Each wing portion 3 consists of a flange 4 extending outwardly from the adjacent flange 5 of the body portion, a web 6 extending parallel to the flange 5, and a flange 7 extending inwardly from the web 6 parallel to the web 8 of the body portion. The

[*Price 4s. 6d.*]

angles $a$ between each flange 4 and the web 6 on the one hand and the flange 5 on the other hand are each about 82°, so that the flange 4 slopes at an angle of about 8° to the plane of the web 8. The bends are all slightly radiused, as illustrated. The opening 9 between the free edges 10 of the flanges 7 is wider than the internal width 11 of the body portion 2. The overall width dimension 12 of each wing portion 3 is substantially half the external dimension 13 of the body portion 2. Such members may be made in a range of cross-sectional sizes and thicknesses of steel. They may also be made in a range of lengths, or required lengths may be readily cut from standard lengths.

Due to its several bends and the distribution of its webs and flanges, a structural member such as is shown in Figure 1 makes particularly efficient use of its metal in compression and is also capable of sustaining other types of loading effectively. Thus it can be used with economy of material, weight and expense. Members 1 can be partially nested one in another for the sake of compactness during storage or transport.

A convenient size of the member of Figure 1 has, for instance, an overall width of 5 ins. and an overall depth of $3\frac{1}{8}$ ins., the body portion 2 having an internal side of 2 ins. The opening 9 is about 3 ins. wide. A second, otherwise similar, member but with an overall depth of $2\frac{1}{8}$ ins. may have a body portion 2 of rectangular shape with a depth of only $1\frac{1}{8}$ ins. A third, smaller, member shown in Figure 2 has an overall width of 3 ins., an overall depth of $1\frac{7}{8}$ ins. and a rectangular body portion 2 with an internal width 11 of $1\frac{1}{2}$ ins. and internal depth of 1 in. For this member, the opening 9 is only slightly greater than the internal width 11.

Such members can be used alone, singly or in combination, or together with members of other materials to form a variety of structural elements having high load-carrying efficiency. For instance, any of the above - described members may be used, preferably with the web 8 of the body portion 2 on the compression side, as a beam, joist or purlin, or as a column strut, tie, pile or the like. Turned on one side, as shown in Figure 9 for example, members 1 may be used as rails for the mounting of cladding panels. To provide elements of greater strength, two members 1 may be used together, for example back to back, roughly in the form of an I section (Figure 3), with their webs 8 bolted, riveted or spot-welded together as indicated at 14 or connected at the visible lines of joint 15 by continuous or intermittent welding. Alternatively, as shown in Figure 4, two members 1 may be connected together, opening 9 to opening 9, to form an approximately symmetrical cross-shaped section.

When used in conjunction with other materials, for example metal, wood, concrete, rubber, bitumen, asphalt or synthetic resin, the hollow interior of the structural member 1 permits of convenient accommodation of the said material. These materials may form either continuous or discontinuous infillings and may serve to increase the load-carrying capacity of the member 1 and/or to facilitate attachments, as hereinafter described. For instance, with either the first or the second of the sizes of members 1, described with reference to Fig. 1, a length 16 of timber, 2 ins. square, can be freely entered into and snugly accommodated in the channel section of the body portion 2, as shown in Figure 1. Any required position of the timber, for example and as illustrated with its outer face flush with the flanges 7, can be obtained by the introduction of timber packing blocks or strips 17. A length 16 of timber, $1\frac{1}{2}$ ins. square, can be similarly accommodated in the member illustrated in Figure 2 In all cases, the timber may be connected to the member 1 by screws or nails 18 passing through the flanges or webs of the member. As illustrated for the flanges 5 in Figure 6, any of the flanges and/or either of the webs of a member 1 may be preformed with holes 19 at intervals to facilitate connections such as have already been referred to, or other connections or attachments later to be described. Connections may also be made by adhesives.

The members 1 can be used as principal members or as ancillary members for building up more complex elements or structures. A particularly important such use, is in lattice girders or beams, plate girders or beams, roof trusses or the like. For example, in a lattice girder such as is shown in Figures 5 and 6, the booms or flanges of the girder may consist each of one member 1. Alternatively, the upper boom in particular may consist of two members 1 put together to form the cross-shaped section shown in Figure 4 or of two members 1 located back to back but one on each side of channel-section and/or other members forming the web-structure of the girder, as shown in the upper part of Figure 7.

In a lattice girder, the diagonals 20 may be auxiliary members of flat, angle or T-section. Preferably, however, use is made of members of rectangular channel section (Figure 8) designed to receive snugly between their flanges 21 the body portion 2 of a main member 1 used as, or in a boom of, the girder. Figure 8 illustrates a cross section suitable for use with members such as have been described above with reference to Figure 1. To permit of a sufficient area of overlap of the flanges 5 by the flanges 21, the webs 22 of the diagonals 20, can be notched out for the requisite distance, as indicated at 23 in Figure 6. Also corners of the flanges 21 which could foul portions of the adjacent member 1 may be bevelled off or cut away to any extent necessary, especially in the case of shallower girders with less steeply inclined diagonals. Connec-

tions may be made by fillet welds, as indicated at 24 in Figure 6, or by butt welds or one or more spot welds or by resistance welding, or by one or more bolts or rivets, as indicated at 25 in Figure 6.

In the case of plate girders, web plates may be connected to the cuter faces of both flanges 5 of the main members 1 serving as the booms. Such plates may be plain or corrugated and may be stiffened by external or internal angle-section uprights at intervals. Connections may again be made by welding, bolts or rivets. Angle cleats or other supporting means at the ends of the girder may be attached, suitably by welding or bolting to the flanges 5 or web 8 of the body portion 2.

The structural members 1 lend themselves very readily to the attachment of other structural members or ancillary parts of a building or other structure. For example, as illustrated in Figure 9, a hook bolt 26 for securing corrugated or other wall or roofing sheet 27 or slab material, wall or floor panels or the like can be securely anchored by engaging its hook 28 with a sloping flange 4 of a member 1. As illustrated in Figure 10, a bent-metal clip can be engaged with one end portion 29 around an edge of a panel 30 and hooked with another portion 31 around a wing portion 3 of the member. As shown, two such clips can secure two panels 30 meeting over the centre line of the member 1. In an alternative arrangement, a clamping or clip plate engaged inside the flanges 7 of a member 1 can be used to secure a panel with the assistance of a bolt passed through the panel to receive a nut on the other side of the latter. Clips comprising parts which can be expanded or splayed apart inside the wing portions 3 of a member 1 may also be used for securing or attachment purposes.

In the case of a member 1 having an infilling of timber, aerated or other light concrete or the like, which may be either continuous or discontinuous along the length of the member, panels or other parts may be attached, as shown by way of example in Figure 11 by nails 32 driven into such filling 33 or by screws or by glue or other adhesive. In the case of an element formed by two members 1 back to back, each of the four outwardly presented channels then formed may, if required, be furnished with an infilling 34 (Figure 12), so that any or all of the four sides is available for attachment purposes. Elements built up from two members can be engaged by hook bolts 26 such as are shown in Figure 9 or by ordinary bolts provided with hook or clip plates.

Attachment arrangements such as have been described above, particularly those of Figures 9 and 11, can be used with the member 1 either on its side, as in those figures, or upright.

Brackets, lugs or like parts, for example angle cleats for fixing purlins to a structural member 1, may be welded to the said member. However, to permit of the attachment of such parts by means permitting of easy adjustment along the length of the member 1, use may be made of a stepped clip plate 35 (Figure 13) engageable inside the flanges 7 of the member, the steps lodging against the free edges 10 to prevent turning of the plate. A screw 36 passing through a tapped hole in the middle of the plate 35 and abutting against the web 8 of the member 1 can be tightened to cause the plate to be pressed tightly against the flanges 7. An angle cleat 37 or the like is welded to the middle, elevated, part of the plate 35. As indicated above, a similar arrangement may be used for attaching cladding or other sheet material. As an alternative for the stepped plate 35, use may be made of a plate whose lateral edges are slotted so that they can be arranged to embrace the flanges 7 of the member 1. In a preferred arrangement shown in Figure 14, however, a shorter screw 36 is used and is abutted by means of a shouldered extremity 38 against a plate 39 resting on the insides of the flanges 4 of the member 1 by end parts bent to conform to the slope of the said flanges. The screw 36 has screw-threaded engagement with the stepped plate 35 located inside the flanges 7 of the member 1. With this arrangement, when the screw 36 is tightened, the two plates 39, 35 are spread or splayed apart and grip the flanges 4, 7 from the inside.

WHAT WE CLAIM IS:—

1. A structural member which, in cross section has a general profile of hollow T-shape and comprises a body portion of channel section and two wing portions each of which is of channel section and consists of a flange extending outwardly from the adjacent flange of the body portion and making rather less than a right angle therewith, a web extending substantially parallel to the said flange of the body portion, and a flange extending inwardly from the web substantially parallel to the web of the body portion, the distance between the free edges of the latter flanges of the wing portions being not less than the distance between the insides of the flanges of the body portion.

2. A member according to claim 1, wherein the distance between the said free edges is greater than the distance between the outsides of the flanges of the body portion.

3. A member according to claim 1 or 2, wherein the overall width of each wing portion is substantially half the distance between the outsides of the flanges of the body portion.

4. A member according to any one of claims 1 to 3, wherein the body portion is substantially square in cross section.

5. A member according to any one of claims 1 to 3, wherein the body portion is substantially rectangular in cross section, the depth of the rectangle (in the direction of the stem of

the T-profile) being less the width thereof.

6. A member according to any one of claims 1 to 5 and provided at intervals with holes for nails, screws or the like.

7. A member according to any one of claims 1 to 6 when used in combination with another, like, member attached to it with either the webs of the base portions or the aforesaid latter flanges of the wing portions adjoining each other.

8. A member or members as claimed in any one of claims 1 to 7 when used with an infilling or infillings of other material, for example wood, concrete or the like.

9. A member or members as claimed in any one of claims 1 to 8 when used as parts of a lattice girder, plate girder, beam or like built-up structure.

10. A member or members when used in a lattice girder as claimed in claim 9, the diagonals of the girder being of a channel section dimensioned to receive snuggly between its flanges the body portion of the said member or members.

11. A member or members as claimed in claim 10, wherein the webs of the diagonals are cut away at the ends to permit of a sufficient area of overlap between the flanges of the diagonals and of the said body portion.

12. A member as claimed in any one of claims 1 to 11 when used in conjunction with a hook bolt having its hook portion engaged around a wing portion of a member.

13. A member as claimed in any one of claims 1 to 12 when used in conjunction with a bent clip having one end portion engaged around a panel and another end portion engaged around a wing portion of the member.

14. A member as claimed in any one of claims 1 to 13 when used in conjunction with attachment means comprising a stepped clip plate engaged inside the aforesaid latter flanges of the wing portions with the steps lodging against the free edges thereof, and a screw engaged with the said plate and abutting against the inside of the web of the body portion.

15. A member as claimed in any one of claims 1 to 13 when used in conjunction with attachment means comprising two plates engaged inside the flanges of the body portion and a screw engaged with one of the said plates and abutting against the other, so that the said plates can be splayed apart to grip the said flanges by turning the screw.

16. A structural member substantially as hereinbefore described with reference to Figure 1 or Figure 2 of the accompanying drawings or such a member when used in conjunction with another member or members or other parts substantially as hereinbefore described with reference to any of Figures 3 to 14 of the accompanying drawings.

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Chartered Patent Agents.

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2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 1

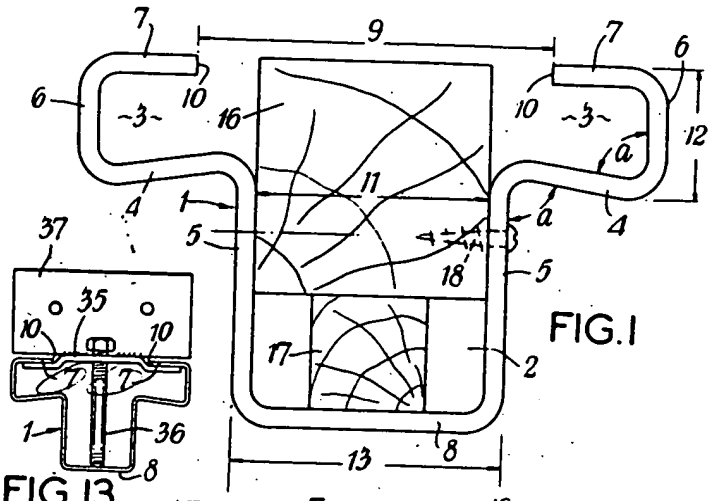


FIG.1

FIG.13

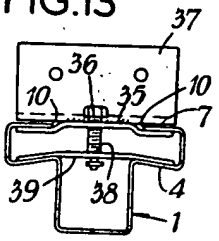


FIG.14

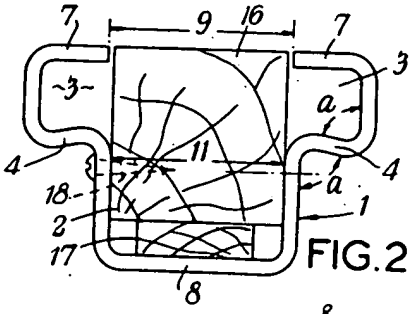


FIG.2

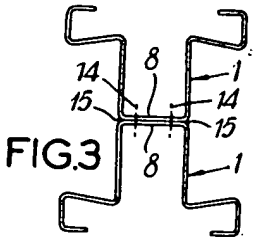


FIG.3

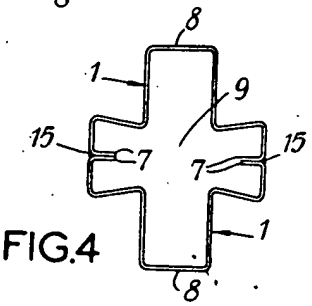


FIG.4

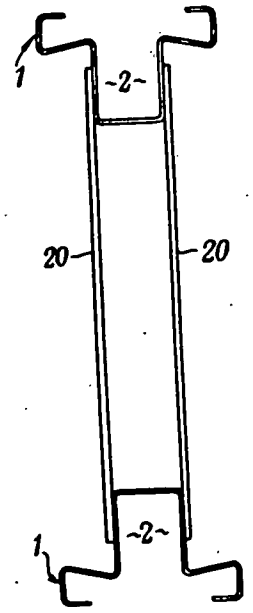


FIG.5

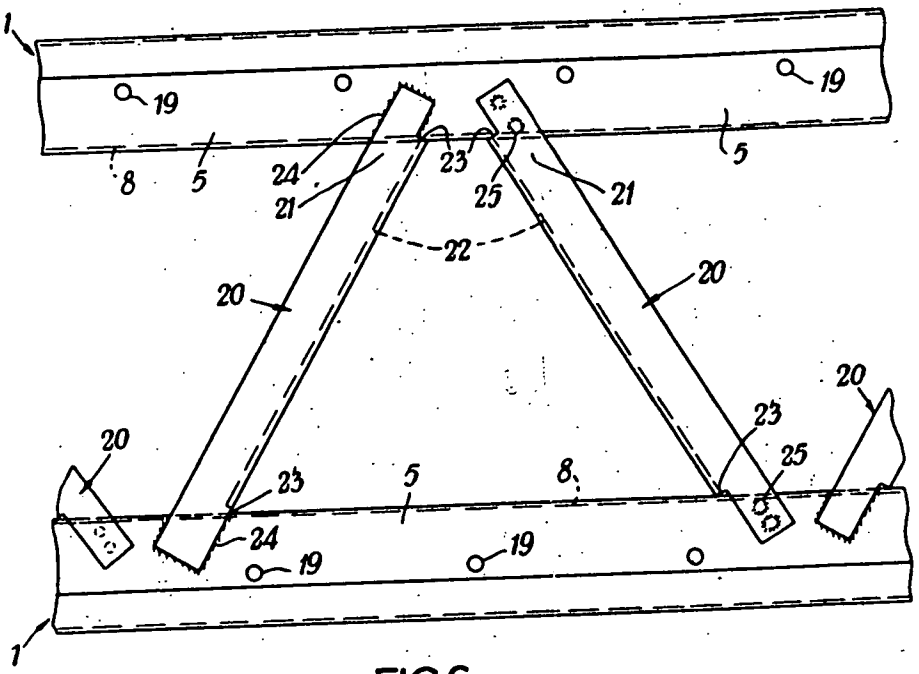


FIG.6

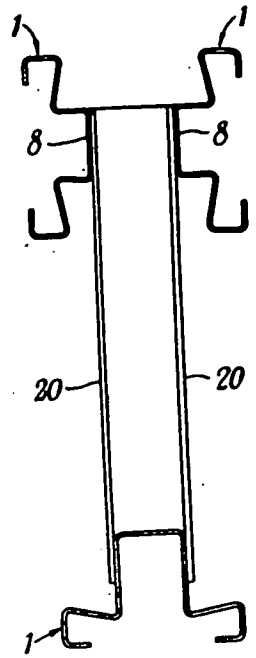


FIG.7

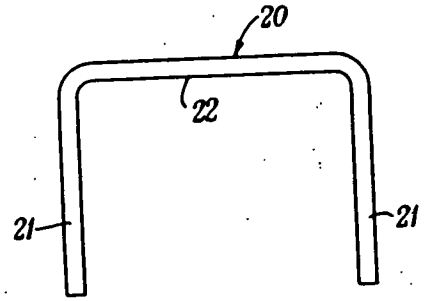


FIG.8

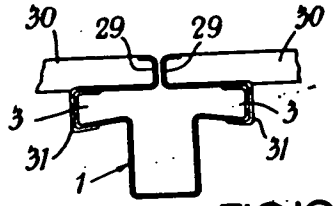


FIG.10

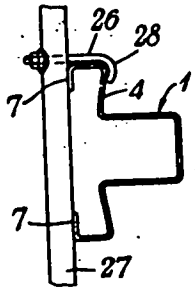


FIG.9

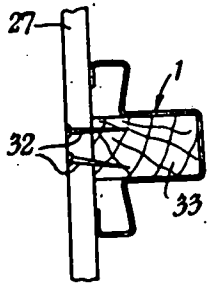


FIG.11

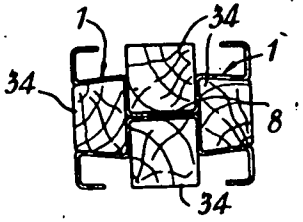


FIG.12